Utilizing Real-World Data for Real-World Calculations

My background in mathematics taught me that I never truly understood the methods of one course until I took the subsequent course. My view is that the first time a student encounters a technique, they are primarily busy learning the mechanics of the calculation. Once the mechanics are solid, the student is ready to see the meaning and usefulness of the calculation. Most students aren't aware that this distinction between mechanics and understanding can be a way to approach mathematics. The result is that students often feel that they are not mathematically inclined when they consistently fail to fully understand a method after just one exposure. This perception can lead to avoidance and delay of college-level mathematics courses.

In my approach to teaching quantitative analysis, I try to provide that subsequent class. In doing so, I emphasize two overarching aspects of quantitative reasoning. One is to convey the steps behind computer-aided calculations; in essence, to demystify the calculation. The second is promoting self-sufficiency by showing students how to get by when a computer isn't available. Both of these aspects help build student's intuition about calculation—their quantitative reasoning.

My approach to teaching quantitative reasoning in the classroom focuses strongly on incorporating real-world data in ways that are enlightening. I feel that it is important for students to see all the flaws and inconsistencies contained in real-world data. Through this lens, I try to build a deeper appreciation for science that moves away from the often implied idea of science-as-magic. For this to work, the questions and investigations students are asked to undertake also need to be meaningful. The quantitative questions they ask should yield meaningful results. They should be questions and results that would be asked and obtained by professionals on a regular basis.

My approach to removing the apparent magical aspect to calculations is through manual calculation. I value manual calculation as an integral stepping stone to computer-assisted calculation. However, the incorporation of manual calculation involves treading a fine-line, since the purpose, in my mind, isn't to demonstrate to the student that computers make things faster and less tedious. The value in the act of manually performing a calculation should be insight for the student into how a technique works. When designed well, manual calculation can also build self-sufficiency, allowing the student to perform back-of-the-envelope calculations if necessary.

In building these activities, one aspect that I find most challenging revolves around fulfilling the criteria of meaningfulness of calculation and clarity of insight early in the curriculum. I want to be able to answer the honest question of why we are calculating a value. Contrastingly, I have also found it difficult to tailor activities to prevent students from falling into the plug-and-chug mindset they often have later in the curriculum. This is exemplified by students who still ask what the *right* answer is, or will refer to published values as the *true* answer, when comparing their results.